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AGRICULTURE/FORESTRY
HYDROLOGY

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Mr. Frederick Gordon
Technical Monitor
Code 902
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Greenbelt, Maryland 20771

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TYPE II QUARTERLY REPORT

I. INTRODUCTION

The main objectives of the Mekong Committee investigations using LANDSAT-2 data are as follows:

A. Short-term objectives

By both photo-interpretation and automatic data processing techniques, supported by ground truth data and field surveys, establish:

- Land use, land capability and hydro-geomorphology maps of the lower Mekong basin;
- Maps showing primary forests and deciduous forest areas;
- Maps showing consecutive flood and drainage patterns of Mekong lowlands.

B. Long-term objectives

Organise a research programme for classification of agricultural crops and land use, and for soil moisture monitoring for crop forecasting.

II. TECHNIQUES

1. Data quality and delivery

The data received during the period under review is listed in Annex 1.

Also a list of LANDSAT-2 imagery received since the beginning of our investigations is provided in Annex 2. It should be noted that 105 imagery from a total of 237 imagery received are outside the area of our investigation. As these imagery are not useful to our investigations its costs should not be charged against our LANDSAT ACCOUNT No. G 29960

2. Preparation of land use, land capability and hydro-geomorphology maps.

No new development.

3. Research programme for computer processing of remote sensing data.

It is now decided to use the computer programme RECOG instead of the LARSYS package as indicated in the last progress report.

AIT had terminated the CDC 3600 computer system in October 1975 and has replaced it by a new IBM 370/145 computer system in March 1976. Though the new IBM 370/145 computer is now in operation but only recently, a little progress has been made on this part. The work on the development of the software has begun as soon as the computer is available.

III. ACCOMPLISHMENTS DURING THE PERIOD UNDER REVIEW

1. Preparation of land use, land capability and hydro-geomorphology maps.

Work continued on the preparation of hydro-geomorphology map.

Annex 3 provides explicative notes on the Land System Map of the lower Mekong basin prepared by way of interpretation of satellite photographs, mainly false color composites generated from black and white film material.

2. Research programme for computer processing of remote sensing data.

Collection of ground truth data continued at site Number 1 and Number 2 indicated in the last progress report.

The information has been edited and recorded in computer files for future use. All data on the ground truth observation have been now transferred to the new IBM 370/145 computer system.

IV. CONCLUSION

Work on the general mapping programme progressed satisfactorily.

The research programme for computer processing of remote sensing data has been delayed due to the change of the computer system at AIT. It is expected that a substantial progress will be made during the following reporting period, as the new IBM 370/145 computer is now in operation.

3- Annex 1

LIST OF LANDSAT - 2 IMAGERY

RECEIVED BY THE MEKONG SECRETARIAT

(Period March-May 1976)

#	I D number	Cover the Mekong basin	Outside the Mekong basin	Date acquired (month, day, year)	Remarks (localization)
1	2324-02462	x		12/12/75	
2	2324-02464	x		12/12/75	
3	2324-04284		x	12/12/75	India
4	2333-07033		x	12/21/75	Saudi Arabia
5	2333-07035		x	12/21/75	Red Sea
6	2340-02341	x		12/28/75	
7	2340-02350	x		12/28/75	
8	2340-02353	x		12/28/75	
9	2340-02355	x		12/28/75	
10	2340-02362	x		12/28/75	
11	2342-02452	x		12/30/75	
12	2342-04283		x	12/30/75	India
13	2343-02510	x		12/31/75	
14	2343-02512	x		12/31/75	
15	2343-02515	x		12/31/75	
16	2343-04351		x	12/31/75	India
17	2345-03023	x		01/02/76	
18	2345-03025	x		01/02/76	
19	2345-03032	x		01/02/76	
20	2345-03034	x		01/02/76	
21	2345-04454		x	01/02/76	India
22	2350-06574		x	01/07/76	Saudi Arabia
23	2350-06580		x	01/07/76	Saudi Arabia
24	2350-08405		x	01/07/76	Niger
25	2355-04003		x	01/12/76	Bay of Bengal
TOTAL		15	10		

#	I D number	Cover the Mekong basin	Outside the Mekong basin	Date acquired (month, day, year)	Remarks (localization)
46	2212-02244	x		08/22/75	
47	2248-02250	x		09/27/75	
48	2264-02135	x		10/13/75	
49	2290-02581	x		11/08/75	
50	2301-02193	x		11/19/75	
51	2301-02200	x		11/19/75	
52	2303-02301	x		11/21/75	
53	2303-02303	x		11/21/75	
54	2303-02310	x		11/21/75	
55	2304-02353	x		11/22/75	
56	2304-02362	x		11/22/75	
57	2304-02364	x		11/22/75	
58	2304-02371	x		11/22/75	
59	2304-02373	x		11/22/75	
60	2305-02413	x		11/23/75	
61	2305-02425	x		11/23/75	
62	2306-02463	x		11/24/75	
63	2306-02463	x		11/24/75	
64	2306-02465	x		11/24/75	
65	2306-02472	x		11/24/75	
66	2306-02474	x		11/24/75	
67	2306-02481	x		11/24/75	
68	2308-02570	x		11/26/75	
69	2303-02573	x		11/26/75	
70	2320-02235	x		12/08/75	
71	2320-02241	x		12/08/75	
72	2320-02250	x		12/08/75	
73	2320-02253	x		12/08/75	
74	2320-02255	x		12/08/75	
75	2321-02313	x		12/09/75	
76	2323-02403	x		12/11/75	
77	2323-02410	x		12/11/75	
78	2324-02462	x		12/12/75	
79	2324-02464	x		12/12/75	
80	2324-04284		x	12/12/75	India
81	2326-02581	x		12/14/75	
82	2326-04401		x	12/14/75	India
83	2327-04455		x	12/15/75	India
84	2330-06462		x	12/18/75	Saudi Arabia
85	2330-06464		x	12/18/75	Saudi Arabia
86	2330-08293		x	12/18/75	Chad
87	2330-08300		x	12/18/75	Chad
88	2331-03264		x	12/19/75	Bay of Bengal
89	2332-03311		x	12/20/75	Burma
90	2332-03314		x	12/20/75	Bay of Bengal
91	2332-03320		x	12/20/75	Bay of Bengal
92	2332-03323		x	12/20/75	Bay of Bengal
93	2333-03370		x	12/21/75	Bay of Bengal
94	2333-03373		x	12/21/75	Bay of Bengal
95	2333-03375		x	12/21/75	Bay of Bengal

3- Annex 2

LIST OF LANDSAT - 2 IMAGERY

RECEIVED BY THE MEKONG SECRETARIAT

(As of May 1976)

#	I D number	Cover the Mekong basin	Outside the Mekong basin	Date acquired (month, day, year)	Remarks (localization)
1	2048-02152	x		03/11/75	
2	2048-02155	x		03/11/75	
3	2049-02204	x		03/12/75	
4	2049-02211	x		03/12/75	
5	2049-02213	x		03/12/75	
6	2049-02220	x		03/12/75	
7	2051-02312	x		03/14/75	
8	2051-02314	x		03/14/75	
9	2051-02323	x		03/14/75	
10	2051-02335	x		03/14/75	
11	2051-02341	x		03/14/75	
12	2053-02440	x		03/16/75	
13	2053-02442	x		03/16/75	
14	2053-02445	x		03/16/75	
15	2067-02205	x		03/30/75	
16	2067-02212	x		03/30/75	
17	2067-02214	x		03/30/75	
18	2069-02325	x		04/01/75	
19	2069-02331	x		04/01/75	
20	2070-02392	x		04/02/75	
21	2073-02534	x		04/05/75	
22	2073-02541	x		04/05/75	
23	2073-02543	x		04/05/75	
24	2075-03044	x		04/07/75	
25	2075-03051	x		04/07/75	
26	2075-03053	x		04/07/75	
27	2088-02360	x		04/20/75	
28	2106-02355	x		05/08/75	
29	2108-02472	x		05/10/75	
30	2139-02203	x		06/10/75	
31	2157-02203	x		06/28/75	
32	2162-02491	x		07/03/75	
33	2162-02494	x		07/03/75	
34	2162-02500	x		07/03/75	
35	2163-02543	x		07/04/75	
36	2163-02550	x		07/04/75	
37	2163-02552	x		07/04/75	
38	2164-02595	x		07/05/75	
39	2179-02414	x		07/20/75	
40	2192-02144	x		08/02/75	
41	2192-02151	x		08/02/75	
42	2210-02141	x		08/20/75	
43	2210-02143	x		08/20/75	
44	2211-02195	x		08/21/75	
45	2211-02201	x		08/21/75	

#	I D number	Cover the Mekong basin	Outside the Mekong basin	Date acquired (month, day, year)	Remarks (localization)
96	2333-07033		x	12/21/75	Saudi Arabia
97	2333-07035		x	12/21/75	Red Sea
98	2334-03424		x	12/22/75	Bay of Bengal
99	2334-03431		x	12/22/75	Bay of Bengal
100	2334-03433		x	12/22/75	Bay of Bengal
101	2334-03440		x	12/22/75	Bay of Bengal
102	2336-07204		x	12/24/75	Sudan
103	2336-07211		x	12/24/75	Sudan
104	2337-07262		x	12/25/75	Sudan
105	2340-02341	x		12/28/75	
106	2340-02350	x		12/28/75	
107	2340-02353	x		12/28/75	
108	2340-02355	x		12/28/75	
109	2340-02362	x		12/28/75	
110	2341-02393	x		12/29/75	
111	2341-02400	x		12/29/75	
112	2341-02402	x		12/29/75	
113	2341-02405	x		12/29/75	
114	2341-02411	x		12/29/75	
115	2341-02414	x		12/29/75	
116	2342-02452	x		12/30/75	
117	2342-04283		x	12/30/75	India
118	2343-02510	x		12/31/75	
119	2343-02512	x		12/31/75	
120	2343-02515	x		12/31/75	
121	2343-04351		x	12/31/75	India
122	2344-04400		x	01/01/76	India
123	2345-03023	x		01/02/76	
124	2345-03025	x		01/02/76	
125	2345-03032	x		01/02/76	
126	2345-03034	x		01/02/76	
127	2345-04454		x	01/02/76	India
128	2345-08124		x	01/02/76	Chad
129	2346-03081		x	01/03/76	Burma
130	2346-03084		x	01/03/76	Thailand
131	2346-06351		x	01/03/76	Saudi Arabia
132	2347-03135		x	01/04/76	Burma
133	2347-03142		x	01/04/76	Burma
134	2347-03144		x	01/04/76	Burma
135	2347-03151		x	01/04/76	Burma
136	2347-06403		x	01/04/76	Saudi Arabia
137	2347-06405		x	01/04/76	Saudi Arabia
138	2348-06461		x	01/05/76	Saudi Arabia
139	2348-06464		x	01/05/76	Saudi Arabia
140	2350-06574		x	01/07/76	Saudi Arabia
141	2350-06580		x	01/07/76	Saudi Arabia
142	2350-08405		x	01/07/76	Niger
143	2351-07032		x	01/08/76	Sudan
144	2351-07035		x	01/08/76	Red Sea
145	2351-08464		x	01/08/76	Niger

#	I D number	Cover the Mekong basin	Outside the Mekong basin	Date acquired (month, day, year)	Remarks (localization)
146	2352-07090		x	01/09/76	Red Sea
147	2352-08522		x	01/09/76	Niger
148	2353-03482		x	01/10/76	Bay of Bengal
149	2353-03484		x	01/10/76	Bay of Bengal
150	2354-03540		x	01/11/76	India
151	2354-03543		x	01/11/76	Bay of Bengal
152	2355-04003		x	01/12/76	Bay of Bengal
153	2356-02244	x		01/13/76	
154	2356-07320		x	01/13/76	Sudan
155	2356-07322		x	01/13/76	Sudan
156	2357-02294	x		01/14/76	
157	2357-02300	x		01/14/76	
158	2357-07374		x	01/14/76	Sudan
159	2357-07381		x	01/14/76	Sudan
160	2358-02343	x		01/15/76	
161	2358-04165		x	01/15/76	India
162	2358-04172		x	01/15/76	India
163	2359-02392	x		01/16/76	
164	2359-02395	x		01/16/76	
165	2359-02401	x		01/16/76	
166	2359-02404	x		01/16/76	
167	2359-02410	x		01/16/76	
168	2359-02413	x		01/16/76	
169	2359-02415	x		01/16/76	
170	2359-02422	x		01/16/76	
171	2359-04224		x	01/16/76	India
172	2359-04233		x	01/16/76	India
173	2360-02453	x		01/17/76	
174	2360-02460	x		01/17/76	
175	2360-02462	x		01/17/76	
176	2360-02465	x		01/17/76	
177	2360-02471	x		01/17/76	
178	2360-02474	x		01/17/76	
179	2360-04285		x	01/17/76	India
180	2360-04291		x	01/17/76	India
181	2361-02505	x		01/18/76	
182	2361-02511	x		01/18/76	
183	2361-02520	x		01/18/76	
184	2361-02523	x		01/18/76	
185	2361-02525	x		01/18/76	
186	2361-04341		x	01/18/76	India
187	2361-04343		x	01/18/76	India
188	2361-04350		x	01/18/76	India
189	2362-02563	x		01/19/76	
190	2362-02572	x		01/19/76	
191	2362-02575	x		01/19/76	
192	2362-02581	x		01/19/76	
193	2362-04395		x	01/19/76	India
194	2362-04401		x	01/19/76	India
195	2362-04404		x	01/19/76	India

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#	I D number	Cover the Mekong basin	Outside the Mekong basin	Date acquired (month, day, year)	Remarks (localization)
196	2363-03022	x		01/20/76	
197	2363-03024	x		01/20/76	
198	2363-04453		x	01/20/76	India
199	2363-04460		x	01/20/76	India
200	2363-04462		x	01/20/76	India
201	2363-08120		x	01/20/76	Bay of Bengal
202	2363-08235		x	01/20/76	Chad
203	2364-03080		x	01/21/76	Burma
204	2364-03083		x	01/21/76	Burma
205	2364-03085		x	01/21/76	Burma
206	2364-04512		x	01/21/76	India
207	2364-03092		x	01/21/76	Burma
208	2365-03134		x	01/22/76	Burma
209	2365-03141		x	01/22/76	Burma
210	2365-03143		x	01/22/76	Burma
211	2365-03150		x	01/22/76	Burma
212	2365-08233		x	01/22/76	Chad
213	2365-08235		x	01/22/76	Chad
214	2366-08291		x	01/23/76	Chad
215	2367-03260		x	01/24/76	India
216	2367-03262		x	01/24/76	Bay of Bengal
217	2367-06514		x	01/24/76	Saudi Arabia
218	2367-06521		x	01/24/76	Saudi Arabia
219	2367-08350		x	01/24/76	Chad
220	2368-08404		x	01/25/76	Chad
221	2369-03364		x	01/26/76	Bay of Bengal
222	2369-03373		x	01/26/76	Bay of Bengal
223	2369-03375		x	01/26/76	Bay of Bengal
224	2369-08462		x	01/26/76	Ethiopia
225	2370-03422		x	01/27/76	Bay of Bengal
226	2370-03424		x	01/27/76	Bay of Bengal
227	2370-03431		x	01/27/76	Bay of Bengal
228	2370-03433		x	01/27/76	Bay of Bengal
229	2372-09033		x	01/29/76	Niger
230	2373-02184	x		01/30/76	
231	2373-02191	x		01/30/76	
232	2374-02242	x		01/31/76	
233	2374-02245	x		01/31/76	
234	2374-02251	x		01/31/76	
235	2374-04051		x	01/31/76	India
236	2374-07314		x	01/31/76	Sudan
237	2374-07321		x	01/31/76	Sudan

Total

132

105

EXPLICATIVE NOTES TO THE LAND SYSTEMS MAP OF THE
LOWER MEKONG BASIN PREPARED BY WAY OF THE
INTERPRETATION OF SATELLITE PHOTOGRAPHS,
MAINLY FALSE COLOR COMPOSITES GENERATED
FROM BLACK AND WHITE FILM MATERIAL

F.H. Hildebrand

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I. INTRODUCTION

The purpose of land systems mapping is to identify and delineate entities of land which are large enough to be treated as self-sustaining integrated units. The unit selected here is based on the land system concept which is defined as "an area, or group of areas throughout which there is a recurring pattern of topography, soils and vegetation". This concept was first used in the northern territories of Australia for large-scale planning of extensive areas about which little was known. It was then found suitable for application in parts of Africa and other parts of the tropical world.

The land system is characteristic assemblage of landforms such as hills and valleys soils and vegetation (land use), resulting from three interacting factors, i.e. (1) regional lithology and structure, (2) past and present regional climates and (3) geomorphic evolution. As a well defined unit the land system provides a first approach to the inventory of land resources at a regional scale by providing practical characteristics, e.g. topography, soils, vegetation, lithology, drainage. As such it can be regarded as an appropriate working unit for the assessment of land potentialities (land capability) on a regional level. It further provides a basis for extrapolating experience between similar areas having different geographical locations.

The following explicative note intends to give some background information on the preparation and compilation of the land system map of the area comprising the lower Mekong basin, with the aid of satellite photography, mainly false color composites.*

/ II.

* For the sake of brevity the term false color composite is shortened to FCC, Plural: FCCs. Equivalent terms used in a non-specific sense are: photograph, photography and picture. The term scene is used to indicate the physical equivalent of the area (or landscape) recorded on the FCC. The area under study consists of, or is covered by, 47 such scenes. Black and white is abbreviated to B&W.

II. METHODOLOGY

II.1 General outlook on the terrain

In a very general sense it can be propounded that geomorphologically the lower Mekong basin is composed of 3 major landforms or landform types, i.e. the basins or basin-like surfaces, the plains and other level areas (plateaus) and the areas with relief (hills and mountains). Within the area under study the basins are mainly located in the south. Most of the plains occur in the central part, while mountains form parts of the landscape in the north, and southwest. Intergrades exist between the plains and areas with relief, such as plains with scattered hills and/or ridges, and mountainous areas with inclusions of valley floors. Most of these form a transitional zone of varying width between the plains and the mountainous areas.

The first group of features, i.e. those consisting of one landform or landform type only (basins, plains, areas consisting of hills or of mountains only) can be regarded as mono-elemental units. The intergrades, consisting of two landforms, for instance plains and hills, are bi-elemental units. Units with more than two elements constitute the areas along the major rivers with which their genesis is closely related. They consist of a variety of elements (landforms) such as levees, backswamps, filled oxbow lakes, outwash plains.

A large part of the plains in North East Thailand which on a general level are regarded as having uniform topography appear bi-elemental if considered in detail, i.e. valley bottoms of varying width and length and the inter-valley areas or uplands as they will be called here. Each of these landforms is associated with a specific kind of soil and with a specific kind of vegetation and/or land use. Another landform is represented by what is regarded as a part of a plain, but which general position is slightly higher as compared with that of the rest of that plain, and which is mainly occupied by rice paddies. The area concerned is slightly undulating

and the ricefields located in it are usually lined by trees or trees occur scattered throughout the area, together with termite mounds. By contrast the lower lying areas are completely flat and practically devoid of trees and termite mounds. Rice fields in this area are usually much larger than those in the earlier mentioned area. Extensive terraces of uniform appearance are regarded as plains. Terraces which are strongly dissected (terrace remnants) and which have assumed the appearance of hills are recorded as such. Plains thus can be mono-elemental in which case they are almost perfectly level, such as the extensive plains where most of the ricefields are located (Mekong Delta) or they can be bi-elemental such as those consisting of valley bottoms (or valley floors) and uplands (Northeast Thailand). It should be noted that for the moment the mode of description and the terms used in the legend are mainly morphophenetic, that is without reference to the genesis of the area in question. Any terms implying a morphogenesis of some sort, as for example terrace and pediment, are used in a purely descriptive sense.

II.2 The interpretation of physiographic features

The interpretation of physiographic features and combinations of these with the aid of FCCs follows different lines as compared with that the same using aerial photographs. This is mainly due to the fact that, apart from very small margin along the cross-track sides of each scene, satellite photography offers no possibility of stereo-viewing. Furthermore, because of scale (1:1,000,000) and related to this resolution, mainly large-size landscape features can be recognized. Because of the large coverage FCCs offers overview of the area to be studied, and therefore a better possibility for discerning landscape features occurring in groups or patterns. The recognition and description of such terrain patterns, or land systems as they are called here, requires some knowledge of the relationships between landforms and their image on satellite photography. There are two kinds basic factors involving the assessment of the form of the land. These are drainage conditions and shadow

patterns. Drainage conditions, in particular those which are less favourable, are a particular property of plains and plain-like areas. They show up on the FCC in varying degrees of bluish-violet color. As a general rule the deeper parts of the plain show up in dark tones of bluish-violet, indicating unfavourable drainage conditions while colors corresponding with the higher lying and drier areas are usually almost yellowish white. In view of the slight differences in local relief shadows due to it are practically absent. By contrast all relief features (hills, mountains, mountain ranges) are pictured with concomitant imagery of shadows or shadow patterns. Drainage conditions are usually good and colors associated with the less favourable conditions are thus absent. If such colors would occur they are likely masked by the imagery of shadows. The degree of definition and intensity of shadow patterns produce an impression of the spatial dimensions and roughness of any particular relief form, for instance the shadow pattern a group of low hills shows up as a barely visible dark coloured fine network, while that of a group of rugged mountains is coarse and clearly defined. Between these extremes there is a variety of relief forms each of which corresponds with a particular shadow pattern cum drainage pattern. In some cases redtones may also serve as a criterion for class distinction. The correct assessment of the lower relief forms, like the various types of hills, is more difficult than that of the different types of mountains, since in the case of hills the effect of vegetation, obscuring relief forms, is greater than in the case of mountains, where relief forms are more pronounced and of a larger size. It appears that the obscuring effect of vegetation is minimal in the dry season and the identification of the lower relief forms is therefore easier when end January and February FCCs are studied. Hills as compared with the higher relief forms often have a more subdued appearance because of the rather gradual transition of adjacent hillslopes and between hillslopes and level areas and shadows are therefore not so clearly defined. Appendix 1 gives an overview of the types of relief forms found appropriate for descriptive purposes.

II.3 Legend

The terms used in the legend, as shown in appendix 1 are derived from sources concerned with the description of the land. Slight modifications were made and a number of new terms were introduced to describe each land system as adequately as possible. To succinctly describe each mapping unit and for convenient registration on the map a formula is used consisting of symbols, each of which stands for a specific term or statement describing the most important aspects of each unit. These aspects are: terrain configuration, intensity of incision, drainage intensity and rate of spacing of relief elements in the areas constituting the plains. The symbols are ordered in such a way that the symbol representing the terrain configuration occupies the first two places in the formula, followed respectively by intensity of incision; third place, drainage intensity: fourth place, and rate of spacing of relief elements in plain: fifth place. Occasionally a formula is made up of two formulas separated by an inclined stroke. In this case the first formula expresses the nature of the most important landscape element (usually either plain or hill). The next one describes the element second in importance. It will be noted later that the complex land system cannot satisfactorily be expressed in a formula as it is done with respect to the normal land systems.

II.4 Technique

The land system mapping of the lower Mekong basin, comprising an area of approximately 620,000 square kilometers, and covering parts of Laos, Cambodia, Viet-Nam and Thailand, was carried out with the aid of FCCs generated from satellite photography consisting of black and white film material. The interpretation was done by delimitating colour patterns depicted on each FCC on a piece of transparent overlay which for this purpose was superimposed on the satellite photograph being studied, whereafter both were laid out on a light table. A base map at scale 1 to 1,000,000 and covering the whole lower Mekong basin, including some adjacent

areas was constructed from an assembly of topographic maps of the same scale. After adjusting for scale differences between overlay and base map details on the overlay were transferred to the 1:1,000,000 scale base-map. Topographic maps and thematic maps (soils, vegetation, land capability) were used for comparison and correlation of data and for the extrapolation of information to parts of the area being studied of which no adequate information was available. Occasionally other data sources were used to for rectification and control. For the moment data collection is only concerned with land forms.

II.5 Problems connected with the delineation of landsystem boundaries

The land system is an abstract entity (a construction of the mind) and for this reason it is not verifiable in the field in contrast to for instance the land form which is a very tangible object. Different interpreters may therefore be at variance as to the correct location of a boundary separating adjacent land systems, especially when one land system gradually merges into any other. In such cases no guarantee can be given as regards the correctness of boundaries.

By definition a land system is composed of a number of land forms which usually are small in number and of limited size. However, these may be land forms which are so extensive in size that ought to be regarded as separate land systems. For instance, the vast and almost level plains around the Tonle Sap Lake in Cambodia is a landform which due to its large size is regarded as a separate land system. Landforms of the same flat nature, here called valley bottoms, occurring in the Northeast of Thailand in alternation with intervalley areas, are not regarded as separate land systems because of their very limited size. Also, huge single mountain ranges are landforms which are regarded as separate land systems. Ridges of much more limited size and extent and occurring in alternation with other landforms, usually plain-like areas, are regarded as parts of a land systems rather than separate land systems.

Between these extremes hesitancy and doubt may occur when deciding whether of a group of recurring landforms each of the landforms is to be regarded as a separate land system, or whether the size these landforms justifies that each of them is regarded as separate land systems. As in the previous case different interpreters would probably assign different status to such a group of land forms. A pattern-like occurrence is the main criteria for the delimitation of land systems. Most land systems are of this nature. It may happen that the different landforms occur in such a haphazard way that together they are hardly recognisable as a pattern although collectively they form a unit which can be separated from other units. The term complex land system is assigned to this kind of unit. Most of the valley bottoms along the main rivers and the adjacent areas affected by them belong to the group of complex land systems. Some areas composed of valley bottoms and relief forms of different origin also come under the group of complex land systems. It will be discussed later in this paper at for easy recollection and description each of the units recognized is expressed in a formula. It is noted in this connection that because of its complex nature such a notation is hardly possible for the complex land system.

III. PREPARATORY WORK AND COMMENTARY

III.1 Suitability of satellite photography for interpretation

FCCs derived from black and white positive film material issued in the years 1972 and 1973 were used for the interpretation of land system. Regrettably not all the FCCs are suitable for this purpose. An assessment to define the suitability of the available colour composites, on the basis of contrast and the presence or absence of cloud images, revealed that of the total of 147 frames 30% is suitable for interpretation and 30% fairly suitable, the remaining being unsuitable for interpretation due to insufficient contrast or excessive cloud-coverage. Of the total of 47 scenes covering the area under study about 68% consists of at least one copy of a fair quality FCC, while 51% consists of FCCs of good

/quality.

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quality. As a measure for monitoring changes in for instance, vegetation, it is reasoned that at least three FCCs of the same scene and taken at intervals long enough to detect changes are needed. It was found that somewhat less than 10% of the total of scenes making up the area under study consists of three consecutive FCCs of respectively fair and good quality. However, fair quality FCCs could be successfully used if accompanied by the consultation of relevant data sources. The good and fair quality FCCs collectively cover approximately 82% of the area under study.

III.2 Correlations

Comparison of the satellite imagery and with corresponding thematic maps is of importance to establish correlations and thus reduce the amount of expensive and time-consuming field work to a bare minimum. On comparing land system boundaries with those shown on thematic maps, a lack of correspondence between respective boundaries was often noticed. In the case of the geological map of Thailand this even applies to obvious boundaries, i.e. those which are easily perceivable on the FCCs. In the case of the soil map, which is based on taxonomic units, correspondence between boundaries shown by respectively the soil map and land systems map is not quite evident. This could be expected since land systems mapping is not based on classification in a taxonomic sense. It is physical sub-division (breakdown) of the land into units of uniform appearance rather than a grouping into taxonomic units. This means that correspondence between boundaries of the land system map and analogous thematic maps, whose classification is mainly based on distinguishing characteristics, is rather an exception than a rule. Since the land system map essentially is a landform association map (each unit is an assembly of recurrent landforms) agreement between boundaries can be expected if it is compared with a soils association map. The somewhat too detailed for correlation with the land systems map as prepared with the aid of FCCs. On the other hand it seems that such maps are not detailed enough as soils associated with specific landforms of somewhat

limited use, but still perceivable on the FCC, are not mentioned on the general soils map. Medium scale soil maps showing such detail are available, but these are existent for limited areas only.

III.3 Legend

Several trials were made to prepare a legend which is comprehensive enough to be applicable to all the varying conditions of physiography present in lower Mekong basin. The last outlay is shown in appendix 1.

It should be borne in mind that the symbolic registration of landscape features in terms of a limited number of selected factors as mentioned under legend (II.4), is actually only a convenient means for the comparison and recollection of features which are difficult to describe if they do not occur within the boundaries of one and the same scene. As every landscape unit is a unique entity it is hardly possible to describe it adequately in the above way. It has already been noted under (II.3) that the characteristics of the complex land system cannot adequately be expressed in a formula. The ultimate purpose should be a comprehensive verbal description of each unit delineated, which means that a complete statement as regards all the morphological aspects of that particular landscape should be made. There is thus little justification in further elaborating the procedure as described earlier under II.4.

III.4 Technique

Little is known concerning of the interpretation of satellite photography covering an area as large as the Mekong basin. An appropriate interpretation technique had therefore to be developed. Much time and efforts were invested in trying out various materials and ways of interpretation. Insight into the essentials of the subject matter developed gradually.

III.5 Field checks

No field checks were done because large parts of the area under study are not accessible and lately also because of the lack of funds. If field checks could be done these would mainly consist of surveying the representative parts of area under study by rapidly travelling along the major roads. Pictures of the landscape can be taken while cruising the landscape. It should be noted that roads are mostly built on locations which are regarded as most from the road builder's point of view, but which direct surroundings are not always representative of the landscape in which the road is located.

III.6 Accuracy

The correct location of boundaries between adjacent units varies with the quality of the satellite photography and the degree of physiographic contrast between adjacent units. The level of accuracy is highest when photography with optimal photographic and physiographic contrast and with cloud-free imagery are used. FCCs possessing such qualities are usually those which are taken in the period between January and early March.

It is rather unfortunate that only 30% of the total number of FCCs of 1972-1973 are of good quality. In terms of aerial coverage only 20% of the area, equivalent to 20% of the total of scenes 47 is covered by at least one FCC of good quality. It is expected that results can be improved when the satellite photography produced in 1975 and 1976 Landsat II are put to use. This photography seems to be of better quality than those produced in 1972 (ERTS-I).

Attempts were made to raise the level of correctness of boundary locations resulting from the interpretation of the fair quality satellite photography, by using supplemental data, such as those derived from aerial photo-indices.

In the early stages of the interpretation class distinctions with respect to altitude were made solely on the basis of experience and insight. At the time of the near-completion of the first draft of the land systems map, topographic maps at scale 1:1,000,000 showing spot elevations, became available and these were then used to check the units according to their local altitudes, that is in the case of forms with relief with respect to the nearest extensive plain. Other data sources proved to be very useful for comparison and correction when they became available.

IV. CONCLUSION

The present land systems map only contains a description of landforms and it is therefore incomplete without a legend describing the soils and vegetation types occurring in each of the land systems. Both of these have to be added to the present legend in order that, together with the land systems map, it can serve as a proper basis for the land capability classification.

From the foregoing can be surmised that a number of difficulties of mainly technical and methodical nature caused delays in the final issue of the land systems map. The author is of the opinion that with a proper outline for the interpretation of satellite photography and adequate documentation the present work can be done up as in half the time so far spent omit the merits of the land system or any equivalent concept.

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Appendix 1

LEGEND

LAND SYSTEMS MAPPING

of the Lower Mekong Basin

List of terms and symbols

PHYSIOGRAPHY

Terrain configuration (first and second place in formula).

- | | | | |
|----|---|----|--|
| 00 | Shallow depression or basin-like area. | | |
| 01 | Level or nearly level plain | | |
| 02 | Undulating terrain | | |
| 03 | Rolling terrain | | |
| 04 | Slightly sloping or sloping terrain (pediment) | | |
| 05 | Area consisting of low hills and rock outcrops | 05 | Area consisting of low ridges. |
| 06 | Area consisting of hills. | 06 | Area consisting of ridges. |
| 07 | Area consisting of high hills. | 07 | Area consisting of high ridges. |
| 08 | Area consisting of low mountain(s) Altitude mostly ranging between 300 and 700 meter (980-2300 ft). | 08 | Area consisting of mountain ranges. Altitude mostly between 300 and 700 meter (980-2300 ft). |
| 09 | Rough mountainous area. Altitude mostly ranging between 700 and 1200 meters (2300-4000 ft). | 09 | Area consisting of rough mountain ranges. Altitude Mostly between 700 and 1200 meter (2000-4000 ft). |
| 10 | Rugged mountainous area. Altitude mostly ranging between 1200 and 1800 meters or feet (4000-6000 ft). | 10 | Rugged mountain ranges. Altitude mostly ranging between 1200 and 1800 meters (4000-6000 ft). |
| 11 | Alpine mountain. Altitude mostly over 1800 meters or feet (over 6000 ft). | | |
| 12 | Area mainly consisting of escarpments. Varying altitude but difference in altitude between the highest and the lowest parts usually not less than 500 m (1600 ft). | | |
| P | Area consisting of a plateau or closely spaced plateau remnants; plateau level usually above 500 meters (1600 ft). Plateau configuration is described as indicated under 01 to 04. For instance, p02 means: plateau consisting of undulating terrain. | | |

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Intensity of incision (third place in formula).

Mainly as a result of geological erosion.

- | | |
|--|---|
| <p>1. As an applied to relief elements.
(05 to 12 of configuration)</p> <p>n Not or slightly incised
w Somewhat incised
m Moderately incised
s Strongly incised
v Variably incised</p> | <p>2. As generally applied to the relief elements constituting the different types of plains (01 to 04 of configuration), in particular to the often narrow areas of transition between these elements. This information is predominantly derived from serial photographs.</p> <p>w Somewhat broken
m Moderately broken
s Strongly broken
v Variably broken</p> |
|--|---|

Drainage intensity (fourth place in formula).

Mainly applied to areas with relief (surface configuration 02 to 13) and also to relief elements in case these occur individually e.g. a single ridge or mountain range.

- a Very coarse
- b Coarse
- c Medium
- d Fine
- e Very fine
- f Variable

Rate of spacing of relief elements in plain (fifth place in formula).

The second part of the formula applies to this criterion.

- 1. Closely spaced
- 2. Somewhat widely spaced
- 3. Widely spaced (scattered)
- 4. Very widely spaced
- 5. Variably spaced

Inclusion of level terrain (sixth to eight place in formula).

Mainly consisting of flat or slightly sloping elongated valley bottoms (or valley floors), and mainly occurring along major tributaries; mainly applied to areas with relief..

Number of inclusions

Size of inclusions

- : 0 Very few
- : 1 Few
- : 2 Common

- a Small
- b Medium
- c Variable

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